

What is claimed is:

1. A mobile communication apparatus including a base station having multiple antennas and at least two mobile stations having multiple antennas,
5 wherein the base station restores from feedback signals transmitted from the mobile stations weight information determined in the mobile stations, generates from the restored weight information downlink control information ensuring maximum throughput to each of the mobile stations, and selects from among data of all of the mobile stations data
10 of at least one desired mobile station to be transmitted, based on the downlink control information,
each of the mobile stations has at least one mobile station antenna, the base station has at least two base station antennas, and the downlink control information includes mobile station selection
15 information, an optimal basis matrix index, and optimal gain indices.
2. The mobile communication apparatus of claim 1, wherein the base station performs a predetermined signal process on the data of the desired mobile station(s), which are selected based on the downlink
20 control information, matrix-multiplies the processed data by a basis matrix selected based on the downlink control information to generate data signals, adds mobile station bit size information and the pilot channel signals to the data signals, and transmits the added results to the desired mobile station(s) on a frame by frame basis.
25
3. The mobile communication apparatus of claim 2, wherein the predetermined signal process includes modulating and coding the data selected based on the downlink control information, adjusting the gains of the modulated and coded data, and spreading the bandwidths
30 of the gain-adjusted data.

4. The mobile communication apparatus of claim 1, wherein each of the mobile stations measures the channel downlink characteristics of the base station and mobile station antennas based on the pilot channel signals transmitted from the base station, determines the weight information based on the channel downlink characteristics, converts the determined weight information into one of the feedback signals, transmits the converted feedback signal to the base station, and detects a high-speed downlink shared channel signal in units of a frame based on the channel downlink characteristics and based on mobile station bit size information and data signals received from the base station.

5. The mobile communication apparatus of claim 1, wherein the base station comprises:

a feedback information restoration unit which restores from the feedback signals received from the mobile stations the weight information of each of the mobile stations and outputs the restored weight information;

a downlink control information generation unit which generates the downlink control information based on the restored weight information received from the feedback information restoration unit and outputs the generated downlink control information; and

a mobile station data selection unit which selects from among the data of all of the mobile stations the data of each of the desired mobile stations based on the mobile station selection information, extracts from the selected data an amount of data of each of the desired mobile stations based on a predetermined bit size of each of the desired mobile stations, and combines the extracted data into frames with respect to each of the desired mobile stations.

6. The mobile communication apparatus of claim 5, wherein the base station further comprises:

5 a lookup table storing one or more sets of gain values and one or more sets of basis matrices;

an adaptive modulation and power control unit which selects the bit size of a data frame for each of the mobile stations based on modulation and coding orders, which are obtained based on the optimal gain indices, and outputs the gain values of a set of gain values read
10 from the lookup table, which correspond to the optimal gain indices;

a mobile station control information generation unit which generates mobile station bit size information including the bit size of a data frame for each of the mobile stations and the mobile station selection information;

15 an antenna signal processing unit which converts the mobile station bit size information input from the mobile station control information generation unit into wireless signals and outputs the converted mobile station bit size information as wireless signals;

an adaptive modulation and coding unit which modulates and
20 codes the data frame input from the mobile station data selection unit in units of a frame based on the modulation and coding orders;

a first multiplication unit which multiplies the modulated and coded results by the gain values input from the adaptive modulation and power control unit and outputs the products;

25 a second multiplication unit which multiplies the products input from the first multiplication unit by spread/scramble signal streams and outputs the products;

a basis multiplication unit which matrix-multiplies the products input from the second multiplication unit by a basis matrix having the
30 optimal basis matrix index, which is selected from the set of the basis

matrices corresponding to the optimal basis matrix index and read from the lookup table, and outputs the products as data signals; and

an addition unit which adds the mobile station bit size information and pilot channel signals to the data signals, wherein the added results are transmitted on a frame by frame basis to the mobile stations via the base station antennas.

7. The mobile communication apparatus of claim 5, wherein the downlink control information generation unit comprises:

a weight information extension portion which analyzes the gain indices in the restored weight information to find gain values including a null, generates the indices of null basis matrices based on the found gain values including a null and basis matrix indices in the restored weight information, and generates gain indices in the restored weight information as many as the number of generated null basis matrices;

a basis matrix-based classification portion which classifies the generated gain indices for each of the indices of the null basis matrices and the classified gain indices, each of which has the number of a mobile station;

first through J^{th} maximum value selection portions where J is equal to the number of basis matrices, in which a j^{th} maximum value selection portion, where $1 \leq j \leq J$, selects from among the gain indices output from the basis matrix-based classification portion the index of the largest gain value for each of first through N basis vectors of the corresponding basis matrix, and outputs the index of the largest gain value, the value of j , the value of n indicating the number of the basis vector corresponding to the largest gain value, where $1 \leq n \leq N$, and the number of the mobile station corresponding to the largest gain value; and

a transmission order determination portion which selects from among the basis matrix indices the optimal basis matrix index using a

predetermined determination method, selects from among the indices of the largest gain values input from the first through j^{th} maximum value selection portions the indices of the largest gain values corresponding to the optimal basis matrix indices as the optimal gain indices, and selects
5 and transmits from among the numbers of the base stations corresponding to the indices of the largest gain values the number of the base station corresponding to the optimal basis matrix indices, as the mobile station selection information.

10 8. The mobile communication apparatus of claim 7, wherein the j^{th} maximum value selection portion comprises $j1^{\text{st}}$ through jN^{th} maximum value selectors, in which an jn^{th} main gain selector selects from among the gain indices input from the basis matrix-based classification portion the index of the largest gain value, and outputs the
15 index of the largest gain value, the value of j , and the value of n , and the number of the mobile station corresponding to the index of the largest gain value.

 9. The mobile communication apparatus of claim 1, wherein
20 each of the mobile stations comprises:
 a channel characteristics measurement unit which measures the channel downlink characteristics based on the pilot channel signals received via the at least one mobile station antenna;
 a channel information determination unit which determines the
25 weight information ensuring maximum throughput to each of the mobile stations based on the channel downlink characteristics; and
 an information feedback unit which converts the weight information input from the channel information determination unit into the feedback signal and transmits the feedback signal via the at least one
30 mobile station antennas to the base station.

10. The mobile communication apparatus of claim 9, wherein each of the mobile stations further comprises

5 a data information restoration unit which restores data information received via all sub-channels based on the data signals received from the base station and based on the downlink channel characteristics input from the channel characteristics measurement unit;

a data information selection unit which selects from among the data information received via all of the sub-channels only data
10 information received via a desired sub-channel based on a control information, and outputs the selected data information; and

a data information combination unit which combines the data information input from the data information selection unit over a predetermined period of time and outputs the combined result as a
15 high-speed shared channel signal.

11. The mobile communication apparatus of claim 10, wherein each of the mobile stations further comprises a control information restoration unit which restores the control information by compensating
20 for distortion in the mobile station bit size information received from the base station based on the channel downlink characteristics, in which the control information includes information on whether the data signals received via a desired sub-channel have been included in the mobile station bit size information and information on the bit size of the data
25 signals.

12. A method of mobile communications between a base station having multiple antennas and at least two mobile stations having multiple antennas, the method comprising step (a) of:

30 the base station restoring feedback signals transmitted from the

mobile stations weight information determined in the mobile stations,
generating from the restored weight information downlink control
information ensuring maximum throughput to each of the mobile stations,
and selecting from among data of all of the mobile stations data of a
5 desired mobile station to be transmitted, based on the downlink control
information,

wherein each of the mobile stations has at least one mobile
station antenna, the base station has at least two base station antennas,
and the downlink control information includes mobile station selection
10 information, an optimal basis matrix index, and optimal gain indices.

12. The method of claim 11, further comprising step (b) of each
of the mobile stations measuring the channel downlink characteristics of
the base station and mobile station antennas based on the pilot channel
15 signals transmitted from the base station, determining the weight
information based on the channel downlink characteristics, converting
the determined weight information into the feedback signals, transmitting
the converted feedback signal to the base station, and detecting a
high-speed downlink shared channel signal in units of a frame based on
20 the channel downlink characteristics and based on mobile station bit size
information and data signals received from the base station.

13. The method of claim 11 or 12, wherein step (a) comprises:
(a1) restoring from the feedback signals received from the mobile
25 stations the weight information of each of the mobile stations and
outputting the restored weight information;

(a2) generating the downlink control information based on the
restored weight information; and

(a3) selecting from among the data of all of the mobile stations the
30 data of the desired mobile station based on the mobile station selection

information, extracting an amount of data from the selected data based on a predetermined bit size, and combining the extracted data into frames, each of which has the predetermined bit size, for transmission to the desired mobile station.

5

14. The method of claim 13, wherein step (a) comprises:

(a4) finding modulation and coding orders based on the optimal gain indices, finding based on the modulation and coding orders the bit size of a data frame for each of the mobile stations, and selecting from
10 among one or more sets of gain values a set of gain values corresponding to the optimal gain indices;

(a5) generating mobile station bit size information including the bit size of a data frame for each of the mobile stations and the mobile station selection information;

15 (a6) converting the mobile station bit size information into wireless signals and outputting the wireless signals as first control signals; and

(a7) modulating and coding the selected data of the desired mobile station in units of a frame based on the modulation and coding orders;

20 (a8) multiplying the modulated and coded results by the gain values having the optimal gain indices, which are selected from among one or more set of gain values;

(a9) multiplying the products from step (a8) by spread/scramble signal streams;

25 (a10) matrix-multiplying the products from step (a9) by a basis matrix having the optimal basis matrix index, which is selected from the set of the basis matrices corresponding to the optimal basis matrix index and determining the products as the data signals; and

(a11) adding the mobile station bit size information and pilot
30 channel signals to the data signals, wherein the added results are

transmitted on a frame by frame basis to the mobile stations via the base station antennas.

15. The method of claim 13, wherein step (a2) comprises:
- 5 analyzing the gain indices in the restored weight information to fine null gain values, generating the indices of null basis matrices based on the found null gain values and basis matrix indices in the restored weight information, and multiplying the number of gain indices in the restored weight information by the number of generated null basis
- 10 matrices;
- optionally classifying the multiplied number of gain indices according to the indices of the null basis matrices;
- selects from among the optionally classified gain indices the index of the largest gain value for each of first through N basis vectors of each
- 15 of the J basis matrices corresponding to the mobile stations; and
- selecting from among the basis matrix indices the optimal basis matrix index using a predetermined determination method, selecting from among the indices of the largest gain values for the J basis matrices the indices of the largest gain values corresponding to the optimal basis
- 20 matrix indices as the optimal gain indices, selecting from among the numbers of the base stations corresponding to the indices of the largest gain values the number of the base station corresponding to the optimal basis matrix indices, and transmitting the selected number of the base station as the mobile station selection information.

25

16. The method of claim 12, wherein step (b) comprises:
- (b1) measuring the channel downlink characteristics based on the pilot channel signals received via the at least one mobile station antenna;
- 30 (b2) determining the weight information ensuring maximum

throughput to each of the mobile stations based on the channel downlink characteristics; and

(b3) converting the determined weight information into the feedback signals and transmitting the feedback signal via the at least
5 one mobile station antennas to the base station.

17. The method of claim 16, wherein step (b) comprises:

(b4) restoring the first control information by compensating for distortion in the bit size of the data received from the base station based
10 on the channel downlink characteristics, in which the first control information includes information on whether the data signals have been received via a desired sub-channel and information on the bit size of the data signals;

(b5) restoring data information based on the data signals received
15 via all sub-channels from the base station and based on the downlink channel characteristics;

(b6) selecting from among the data information received via all of the sub-channels only data information received via a desired sub-channel based on the first control information; and

20 (b7) combining the data information input over a predetermined period of time and outputting the combined result as the high-speed downlink shared channel signal.